DOSSIER: SCIENCE & TECHNOLOGY

## Pea protein potential

In Upper Volta, as in most countries of West Africa, cowpeas are the most important food legume grown. Not only are they a cheap source of good quality protein, but because of their nitrogen-fixing ability they can be grown on relatively poor soils and the crop residues also help maintain soil fertility.

Although cowpeas are well adapted to the savanna regions because of their tolerance to drought and short growing season, farmers only harvest, on average, 200 kg of grain per hectare. The potential for increased cowpea production is evident, as yields of two tonnes of seed per hectare have been obtained in experimental plots.

In 1971, the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, launched a Grain Legume Improvement Program to help solve some of the problems that limit cowpea production. The aim is to develop cowpea varieties that combine insect and disease resistance with high yields, adaptability to traditional cropping systems, and desired consumer characteristics.

During the past two years, IITAs cowpea collection of some 7000 varieties has been screened for resistance to insects and disease. Close to 1000 varieties have been selected and distributed for trials at 10 locations in West Africa. The best varieties will then be yield tested throughout the tropics. The improved genetic stocks are being provided to national research and extension programs in other countries, along with the technology, as part of a cooperative endeavor. For example, in Upper Volta, an IITA plant breeder is helping local staff to establish breeding nurseries and carry out field trials as well as to demonstrate the new varieties in farmers' fields.

This IDRC-supported Food Legume Improvement Program also enables staff from Upper Volta to attend training courses at IITA, and graduate students to conduct their thesis research as part of IITA's grain legume program. And because similar training opportunities are provided to young scientists from neighbouring countries with similar environments, there is every prospect that the work begun in Upper Volta will benefit the region as a whole.

# Science helps fill the protein gap

Joseph H. Hulse

Ten years ago, the United Nations General Assembly adopted and published a report that called for international action to avert the impending protein crisis. More recently, a wearisome debate has gone on between those who insist that no worldwide protein problem exists or impends, and others who are convinced that protein malnutrition continues to present a serious threat to many of the world's least privileged.

Estimates of the protein available from different food sources in various regions of the world are averages of very uncertain data, and it is probable that the ranges and standard deviations are very large indeed. Consequently the least privileged, usually the poorest and most vulnerable, have access to average protein intakes considerably lower than those usually quoted.

Among the poor communities of the less developed countries, the high incidence of infectious diseases and debilitating parasites creates a greatly increased demand for protein and energy.

It is among the young children, particularly those of the poorest and least privileged communities, that protein and calorie deficiencies are most prevalent. Because both are familiar, among the poorest, clinicians now prefer the term "protein-calorie malnutrition" (PCM), which comprehends a broad spectrum of conditions associated with malnutrition.

There is strong evidence from many sources to demonstrate a significant relation between income and nutritional well-being. Some of the most acute examples of PCM are to be found among the world's poorest, and it is for this reason that the Agriculture, Food and Nutrition Sciences Division of IDRC has directed greatest concern and priority to the semi-arid tropics, most of whose inhabitants have an average annual per capita income below US$200.

These people rely mainly on cereals, legumes, root crops, and other plant sources for most of their calories and protein, and will probably continue to do so for many years into the future. Some of the problems that present themselves to agricultural, food, and nutrition scientists can be illustrated by sorghum, the principal cereal of the semi-arid tropics.

The average yield of sorghum throughout the semi-arid tropics is about half a ton of grain per hectare per year. Yet on experimental farms in Africa and Asia, cultivars that yield better than 8 tons per hectare are in an advanced state of development. It is by no means a simple or straightforward matter to bring together in a single cereal cultivar the genes that combine high yield, and desirable nutritional, agronomic, and technological properties together with satisfactory utility and acceptability. The first problem is to combine a high yielding capacity with functional properties acceptable to the consumer, and with desirable nutritional composition, and then persuade farmers that these superior cultivars can be grown with greater profit and minimum risk.

The protein present in sorghum as in all seed grains are of two broad classes: first, the structural proteins of the embryo which are of predetermined and invariable composition; second, the storage proteins of the endosperm, the amino acid composition of which can vary significantly. Within sorghums of similar genetic backgrounds, as the percent of protein increases, the percent of lysine (an essential amino acid) in protein decreases. Consequently, as the amount of protein goes up, the nutritional quality of the protein declines.

Recently, sorghum genotypes with a very much higher than average lysine content have been discovered in Ethiopia, and even more recently, a high lysine character has been induced by chemical mutation. Research is in progress in India and at Purdue University (Indiana, USA) to combine either or both of these high lysine genes into a stable genetic background to provide cultivars high in lysine, with average protein content, an acceptable grain quality, and high yield. But since the high lysine genotypes have a


*Sorghum, the principal cereal of the semi-arid tropics, is harvested for insect damage studies in Senegal.*

floury endosperm that tends to chip or shatter in the abrasion-type mills used in a number of developing countries, some measure of compromise may be necessary between nutritional and technological quality.

An interesting opportunity for imaginative collaboration between the plant breeder and the cereal technologist also presents itself. The nutritional quality and digestibility of sorghum is reduced by the high polyphenolic tannin content of the seed coats. But the high tannin sorghums are generally more resistant to bird, insect, and fungal attacks. The ideal objective would be to develop sorghum types with a pericarp (outer seed coat) that resists attack yet is loose enough to be efficiently separated by abrasion milling.

In addition to IDRCs support for research in these and other aspects of sorghum improvement, we are also supporting studies in Africa, Asia, the Near East, and Latin America to increase the yield capability and utility of several food legumes. In fact, the amino acid compositions of cereal grains and legumes are complementary and a combination of roughly two parts cereal to one of legume provides a protein of good nutritional quality. Unfortunately, because of their relatively low yield, per capita production of legumes throughout the developing world is declining in relation to cereals. As with sorghums, a combined effort is required among plant breeders and agronomists to increase yields, and food technologists and home economists to devise simple technologies to enable rural processors in the semi-arid tropics to convert legumes to forms that can be acceptably combined with cereal grains.

Agricultural scientists are pursuing the goals of increased production with zeal and imagination. But though food scientists have served North Americans admirably, food science has contributed less than agricultural science to the needs of developing countries. It is therefore the postproduction system that we must now seek to improve, to ensure that the crops are preserved, used and made available to the consumers, and that the increased harvests are conveyed safely and economically from the regions and seasons of abundance to those of scarcity.

Cereals and legumes are but two of the traditional and conventional protein sources for which there exist immense opportunities to increase production and make distribution more uniform. It is these opportunities scientists and technologists need to pursue, particularly among countries of the Third World, before we seek to discover and devise unfamiliar and unconventional food forms.

Although we are much better informed than we were 25 years ago, there remains much we have yet to learn about how much protein we need; how it can be reliably measured and evaluated; in what form and composition protein is best provided for all conditions of men, women, and children; what factors influence the digestion, absorption, transport, and utilization of protein in the human body; and how much protein and of what quality is truly available at all seasons to all those in greatest need.

Until we answer these and many other relevant questions, wise men will think twice before proclaiming that the protein problem is dead and buried. □

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# Water working

Until this year, the small village of Jedee-Thong in Thailand's Pathumthani Province faced a problem common to too many rural communities in developing countries: the 720 villagers depended on rainwater collected in jars or on water drawn directly from the muddy Chao Phraya river for their needs. But that was before Dr Nguyen Cong Thanh received a Research Associate Award from the IDRC to study the functional design of a water supply system for rural communities. A Canadian environmental engineer teaching at the Asian Institute of Technology (AIT) in Bangkok, Dr Thanh chose to "invest" a part of his grant in the construction of an actual filtration system.

The main problem in the use of tropical surface waters for human consumption is the removal of turbidity particles, mainly clay and suspended silt. The most common removal method is a rapid-rate filtration system in which chemicals are used to coagulate fine particles for further settling and filtration. However, this method is too complex and expensive to install and operate for most villages in developing countries.

The filtration system chosen for Jedee-Thong had been designed and pilot tested at AIT. It consists of a horizontal-flow pre-filter of granite chips to treat the raw water, followed by a vertical slow-sand filter to polish the treated water for human consumption.

In May 1977 the villagers, under the supervision of AITs Physical Plant staff, began construction. In seven months, construction was completed and the system became operational in January 1978.

Both the pre-filter and slow-sand filter have been found to perform remarkably well: about 92 percent of the turbidity particles are removed as are 96 to 99 percent of the coliform organisms. The treated water is "pure like crystal", says Dr Thanh, and, according to the villagers, tastes better than rain water.

How much does this water cost the villagers? The total construction costs — covered by Dr Thanh's grant, a provincial government grant and the village council — amounted to some US$5,000, or about $30 for a family of six. The system now provides 50 litres of water per person per day at an operating cost of $80 a month.

It is expected that the new water system will lead to the development of a total sanitary program for the village.